period was twenty days. After a period of eight months the graft is well consolidated with new bone trabeculæ present in the operation area. The alveolus has remodelled well. Lip sensation is normal. So far there is no recurrence of disease (Fig. 4).

Conclusions.—The case illustrates well the vascularity of the condition confirming the experience of other authors. It also demonstrates that radical resection is unnecessary for giant cell reparative granuloma, at any rate in the first instance.

The response to treatment shows that "quick freeze" homogenous stored bone chips can be successfully used by an intra-oral approach to repair bony defects. It seems reasonable to explore the method further in suitable cases, without resorting to long preparatory courses of antibiotics as recommended by Cohen (1955) and Green (1958).

Acknowledgments.—I should like to thank Mr. R. Sutton Taylor for his kindness in allowing me to treat this case and make this report. I am also grateful to Dr. A. Morgan for the photomicrograph and Dr. P. Kerley for the X-rays.

REFERENCES

BERGER, A. (1947) *J. oral Surg.*, **5**, 154.
COHEN, B. M. (1955) *J. oral Surg.*, **13**, 34.
GREEN, H. G. (1958) *Oral Surg.*, **11**, 453.
JAFFE, H. L. (1953) *Oral Surg.*, **6**, 159.
NEWTON, E. A. (1957) *Oral Surg.*, **10**, 11.
RADCLIFFE, A., and FRIEDMANN, I. (1957) *Brit. J. Surg.*, **45**, 50.
UMIKER, W., and GERRY, R. G. (1954) *Oral Surg.*, **7**, 113.

A Dental Appliance for the Production of Artificial Voice

By R. V. TAIT, B.Sc., L.D.S. R.C.S.
Rickmansworth

THIS appliance has been invented in an attempt to find a satisfactory method whereby patients may produce intelligible speech by artificial means. It is of value to those patients who have lost the use of the vocal cords. The majority of such cases are those where the larynx has been removed in the operations of laryngectomy or laryngopharyngectomy, but the appliance may also find applications in conditions where the vocal cords, though present, cannot function; e.g. in cases of paralysis of the cords, or obstruction of the larynx or trachea relieved by permanent tracheotomy.

Complete loss of voice is a major handicap comparable with blindness and deafness in the sense of isolation it may produce in some patients. Fortunately, the majority of patients who undergo laryngectomy learn to speak by "œsophageal voice". Air is taken into the pharynx or œsophagus and then audibly regurgitated into the mouth. Intelligible speech can be produced by this means. However, those who undergo laryngopharyngectomy, with loss of musculature at the lower part of the pharynx, find the production of œsophageal voice more difficult. This appliance is intended for those who fail to learn the œsophageal method of speaking.

The six most important features of any satisfactory artificial aid to speech are as follows: (1) The appliance must set the air in the mouth in vibration at audible frequency and volume, the fundamental frequency falling within the normal voice range of the patient with overtones resembling as closely as possible those of natural voice. In brief, the artificial voice should sound like natural voice. (2) The appliance must combine clear intelligibility of speech with simplicity of operation. (3) It must be small and easily portable, inconspicuous and generally convenient to use. (4) It must be thoroughly reliable in use, and require little in the way of servicing to maintain it in satisfactory operation. (5) It must be reasonably priced. (6) It must be reasonably economical to operate, not requiring very frequent replacement of expensive batteries.

The new appliance.—Until some better name is suggested, I am referring to the new appliance as an oral vibrator, for the following reasons. There are a number of artificial speech aids which depend for their operation on a vibrating diaphragm external to the mouth. The sound from the diaphragm is usually conveyed into the mouth either by means of a tube or by conduction through the tissues. In this country, these gadgets are generally referred to as "vibrators". I have named my new appliance the oral vibrator because it also produces its sound by means of a vibrating diaphragm, but in this case the diaphragm is worn inside the oral cavity.

The appliance consists of an artificial palate into which is sealed an electromagnetically vibrated diaphragm. In patients who normally wear an upper denture, the appliance is conveniently incorporated into the palate of the upper plate. The coil of the electro-magnet is connected by a fine twin flex coming out of the corner of the mouth to a small box containing a transistorized audio-oscillator (Fig. 1). When the switch on the box is depressed the diaphragm

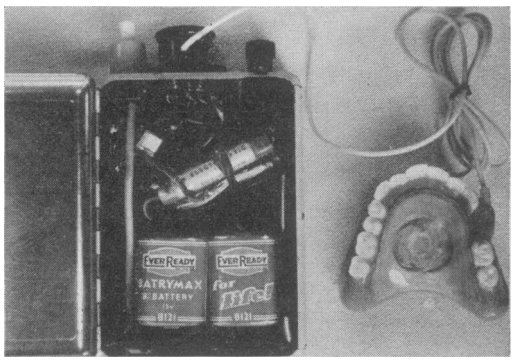

FIG. 1.

in the palate is set in strong vibration, producing an audible note. All that is necessary to produce speech is for the patient to perform normal speech movements of the tongue, lips and jaws, and the sound produced by the diaphragm becomes modulated into words.

I will now consider the extent to which this appliance possesses the six features I have suggested as desirable in an artificial speech aid.

(1) *Naturalness of voice.*—The appliance does not closely simulate natural voice, having a mechanical "buzzer-like" quality. None the less, the quality of voice produced by this appliance compares favourably with that of any other artificial voice I have yet heard. It is very simple to construct the oscillator in such a way that the pitch of voice can be varied by turning a knob on the box, allowing the normal inflections of speech to be closely copied, thereby increasing both the intelligibility and naturalness of voice. Experience so far has shown, however, that patients are not interested in this refinement, preferring to operate the appliance in the simplest possible way even though this produces a less natural quality of voice.

(2) *Intelligibility combined with simplicity of operation.*—Completely intelligible speech is possible with very little practice. Clarity is increased by interrupting the sound between words and for the unvoiced consonants, and the assistance of a speech therapist is valuable in giving the patient a little instruction on these lines. However, the intelligent patient quickly learns to synchronize the operation of the switch with the words, and this appliance is probably the simplest in operation that has yet been devised.

(3) *Convenience.*—The only part of the appliance that need be visible is the flex connecting the electromagnet with the oscillator, and it is therefore less conspicuous than any of the external vibrators. The flex can be made easily detachable from the palate and need only be connected when the appliance is actually being used for talking. The oscillator is comparable in size to a normal hearing-aid amplifier and is conveniently carried in a pocket. One hand is kept in the pocket while talking to operate the switch.

It has not been found that there is any danger of biting the flex, which is attached to the appliance in the buccal sulcus and does not pass between the teeth. But I should point out that I do not advise eating with the appliance in the mouth. The diaphragm is sealed into the palate by a sheet of thin rubber, and if the sealing is damaged the appliance will cease to operate satisfactorily.

(4) *Reliability.*—So far, the only part of the appliance that has given any trouble has been the flex, the weak part of so many electrical appliances. With prolonged use, the flex may break at its attachment to either the palate or the oscillator. However, as the flex is easily detachable at either end, the patient is provided with a spare flex with plugs attached so that an immediate replacement can be made when necessary.

No fault has yet developed in any other part of the appliance. There is no doubt that in course of time the sealing of the diaphragm will deteriorate and require replacement, but this is quite simple to do.

(5) *Cost.*—As the intra-oral part of the appliance must be individually made to fit each patient, requiring the services of a dental surgeon, it cannot be very cheaply produced. It does not, however, contain any very expensive components and the chief factor in determining the cost is the time and skill required for its construction. The cost of the appliance is not out of proportion to its usefulness, and is comparable to that of a hearing-aid.

(6) *Running costs.*—These depend on the type of batteries used. A 9- to 15-volt supply is required and there is no commercially-produced battery that is really suitable. The appliances I have supplied to patients have made use of two Ever-Ready B.121 batteries in parallel and the appliance works very satisfactorily on these. They provide 15 volts and are very small, making it possible to keep the size of the oscillator to a minimum. However, they are certainly not designed to give the fairly large current of approximately 150 milliamps required by this appliance, so their life is short and running costs correspondingly high. A very talkative patient making continuous use of the appliance found that battery replacements cost him about 10s. per week.

If larger cells are used, the running costs can be very greatly reduced, and a 12-volt battery made up of cells of the D.14 type would be far more economical, while still being sufficiently small to

fit into a conveniently sized oscillator. Unfortunately, manufactured batteries of this capacity are not a convenient shape for a small pocket oscillator, being square rather than the flat shape which easily goes into the pocket. If one is prepared to make up batteries of suitable shape from eight D.14 cells, the running costs become trifling.

In discussing these six points, I have tried to make a fair evaluation of the appliance, mentioning both its merits and its shortcomings. In a very limited field it can be of great value to patients suffering from a distressing affliction, greatly increasing the possibility of normal life. Full details of the method of construction of the appliance have been published in the *British Dental Journal.*

In conclusion, while pointing out that this is a thoroughly practical appliance which enables a patient to talk fluently with very little training, I would suggest that there are two main lines for further improvement. First, the quality of the artificial voice needs to resemble natural voice more closely. There are several methods whereby sound can be produced inside the mouth, and experiment with these, with various designs of diaphragm and with different methods of constructing the intra-oral component, may lead to improvement in tone. Secondly, a great advance will be made if the flex can be dispensed with. This is already within view. I have constructed an experimental prototype which operates by radio-control, no wire connexion to the intra-oral component being necessary. This, of course, requires extreme miniaturization of components and batteries. Although I have contrived to get the very bulky prototype into my own capacious mouth, this model has certainly not yet reached a stage at which it is suitable for use by a patient. I hope, however, to be able to report further progress on these lines as suitable miniature components become available.

REFERENCE

TAIT, R. V. (1959) *Brit. dent. J.*, **106**, 336.

Four Cases of External Facial Sinuses of Dental Origin

By DONALD WINSTOCK, F.D.S., B.D.S., M.B.

London

DISCHARGING facial sinuses of dental origin are relatively uncommon. The subject has been reviewed by Anderson (1937), who quoted 2 cases of his own, one with a mental, the other with a cheek sinus. Stones (1954), Bailey and Love (1959) and Thoma (1958) illustrate cases with mental sinuses, whilst Pangman and Gurdin (1953) reported 3 young females with cheek sinuses. The median mental sinus associated with a lower incisal apical abscess closely simulates a sinus of fissural or infected sebaceous cystic origin and is, according to Ormsby and Montgomery (1954), the commonest variety of dento-facial sinus. Sinuses on the cheek have been mistakenly diagnosed as epidermoid cysts, actinomycosis, infected acne and even carcinoma.

The anatomic basis for these sinuses has been investigated by Endleman (1927), who believes that both gravity and the relationship of the infection to the deep cervical fascia determine the eventual site of discharge. Stones relates the site of discharge to the attachments of the buccinator muscle, perforation of the alveolar bone above the upper or below the lower attachments being conducive to fistula formation.

Case I.—A 15-year-old female presented with a discharging sinus on the right cheek. Four months previously, the patient noticed a bluish area on this cheek, preceded by mild, transient toothache. A discharging sinus soon developed, for which local treatment proved unsuccessful and she was referred to the skin clinic and from there to the dental department. Clinically, the lesion consisted of a reddish-purple papilla (Fig. 1) which contained a central punctum from which pus could be expressed by gentle pressure. The surrounding skin was dimpled and partially adherent to the deep tissues. The mouth contained numerous heavily filled teeth, but no bony swelling or soft-tissue lesion, although a firm cord was palpable from the upper right premolar sulcus to the sinus.

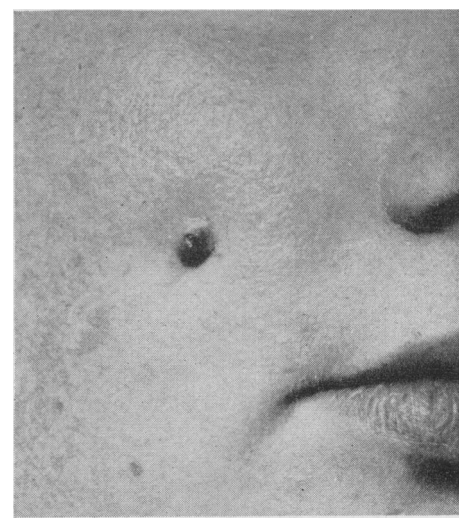

FIG. 1 (*Case I*).